Chapter 4
Falls Prevention in the Home: Challenges for New Technologies

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ABSTRACT
Approximately 1 in 3 people over the age of 65 fall each year; therefore it is of little surprise that falling is often accepted as a natural part of the aging process. Many falls are simply managed using alarm pendants to notify others when a falls event occurs. However, falls technology extends beyond simple notification; technology can be used to screen for falls risk, or to prevent a fall from occurring. In this chapter, we review the latest best practices for the identification of falls risk. We review the technology, if any, developed to support these practices, and discuss the challenges of using technology for in-home falls prevention, risk assessment and falls detection. Recommendations and suggestions for future research directions are discussed.

INTRODUCTION
Falls are of significant social and economic concern, due to the high incidence of falls among the rapidly growing “old” and “old old” populations and the direct and indirect cost of each fall. Approximately 28-35% of people aged 65 and over fall each year, increasing to 32-42% for those over 70 years of age (World Health Organization, 2008). However, it is the impact rather than the occurrence of falls in older adults which is of most concern. Older adults are typically frailer, more unsteady, have slower reactions and thus are more likely to be injured than toddlers and athletes, who also fall regularly. Approximately 40-60% of all reported falls in older adults lead to injuries, of which 30-50% are minor injuries, and 5-6% result in fractures. Most older adults who sustain a fracture following a fall report never regaining previous levels of mobility, and 20% of falls-related hip fractures result in death within 1 year. An injurious fall in a person over 65 can cost the healthcare system US$1049 in Australia (Hendrie et al., 2003) or US$3611 in Finland.
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(Nurmi I. & Lüthje P., 2002). If falls rates are not reduced in the immediate future, the number of injuries caused by falls is projected to double by 2030 (Kannus et al., 2007).

Falling also incurs social and psychological consequences. Socially, a fall can lead to loss of independence and loss of social engagement, as well as broader societal costs and consequences. Psychologically, 54% of people aged over 70 express a fear of falling (G. A. R. Zijlstra et al., 2007), resulting in reduction in their physical and social activities. The main consequences of fear of falling are a decline in physical performance, a decline in mental performance, an increased risk of falling, and progressive loss of health-related quality of life. A fall event can also affect the spouse, family and friends of the person who falls, in particular generating concern for the safety of their loved one. This can result in an increased focus on caring for the older person including considering hiring a carer. It is unsurprising, given the incidence of injury and development of fear of falling, that a recent fall is one of the primary reasons given for moving into nursing homes.

The majority of falls do not result in injury, and many minor trips and stumbles are not reported and are quickly forgotten. However, multi-factorial fall risk assessment is recommended if a fall results in a soft tissue or fracture injury, two or more falls events within a year (recurrent falls), difficulties in walking and balance, or fear of falling are reported. A multi-factorial fall risk assessment can reveal factors that put an individual at risk of falling and can help identify the most appropriate interventions. The risk of falling increases dramatically as the number of risk factors increase. Technologies associated with the falls arena can generally be classified as assisting with detection, assessment, or prevention, and further sorted by the setting to which they belong – acute hospital, nursing home or domiciliary. A variety of falls technologies exist for non-fallers, recent fallers, and recurrent fallers, although the technology requirements vary for each group. An alarm pendant to summon help which may be very useful for a recurrent faller is unnecessary for a non-faller or someone who experiences an occasional accidental fall. Similarly, a challenging balance training game which reduces the risk of falling in non-fallers would be dangerous for a recurrent faller with balance issues.

In the background section of this chapter, we review the strategies developed to identify and treat falls risk factors. We then discuss the role of technology in quantifying and treating these risk factors. In some situations, falls cannot be prevented but the impact of the fall can be reduced through an appropriate application of technology. We then discuss the challenges of developing falls technology for the home and suggest some future research directions. Although older persons in long-term care or older persons with cognitive impairment are at high risk of falling, technology developed specifically for these populations is outside of the scope of this chapter.

BACKGROUND

There is no standard definition for a fall, but the most commonly adopted definition is “an event whereby an individual comes to rest on the ground or another lower level with or without the loss of consciousness”. Each fall event can be further classified (Kenny et al., 2009) according to their self-reported mechanism (explained/unexplained), objective mechanism (extrinsic/intrinsic), severity (non-injurious/injurious) and frequency (single/recurrent). The definition of a faller also varies in the literature but a faller is usually described as someone who has fallen at least once within a set period of time. The latest AGS guidelines (American Geriatrics Society, in press) recommend screening older persons for falls every 12 months.

There are several reasons why older adults fall. Some reasons such as age and gender cannot be modified, and others such as medications,
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